POLYMORPHISM IN *C .nermoralis*

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INTRODUCTION

Polymorphism is the phenomena where two or more phenotypes are observed in the same species. It is a natural process that promotes variation within a species. There are a number of evolutionary mechanisms that may be responsible for polymorphism including genetic drift, gene flow and natural selection. *Cepaea nemoralis* is a common land snail found across Western Europe, which is popular in studies of polymorphism due to its range of easily observable phenotypic traits. These include differences in shell colour (brown, pink or yellow) as well as the presence, number (up to five bands) and appearance of band patterns. The age of *C. nemoralis* can be estimated by the degree of pigmentation at the lip of the shell, with darker lips being found in mature individuals. Snails are model organisms because they are slow moving so they are easy to sample and it can be assumed that migration will have little influence on any polymorphism observed. Additionally snails are valuable in polymorphic research because upon death, their shells remain in the area and can still be sampled. A supergene is responsible for polymorphic traits in *C. nemoralis* shells. This is where genes responsible for colour, presence or absence of bands, lip colour and type of band pigmentation are found located close together on a chromosome. Due to the close proximity of the genes that form the supergene, recombination is rare.

###### Referring back to previous experiments, one cannot help but notice the exploration of competition between sub-species. In one study, the gene frequencies of both *C. nemoralis* and *C. hortensis* (a similar species of snail) were observed based on geographical location. In the south of Britain, *C. hortensis* is almost completely excluded by *C. nemoralis* from dunes. Conversely *C. hortensis* is abundant in the north limit, compared to the sparseness of *C. nemoralis*. These observations show clear illustration of competition between the two and how both species cannot co-habit. Competitive exclusion has also been suggested on a smaller scale for other habitats. However, no further exploration has gone into carrying out the removal of one species in order to investigate the niche expansion by the other .Focusing more specifically on areas of vegetation, studies have been carried out to explore a possible stochastic element in competition. When observing population numbers it was evident that in some places, *C. nemoralis* is abundant, where *C. hortensis* is confined and restricted to woods. However in other areas, it was discovered that the opposite pattern was found. In terms of polymorphism, experimentation was carried out in Oxfordshire regarding the distribution of *C. nemoralis*, by shells colour and bands. In woodland, it was seen that pink shell populations had very high frequencies as compared to other colours. In other locations however, strategies are reversed. In the woodland, an increase in the frequency of these pink snails causes a response in the visual selection in the woodland. Moreover the increase is coupled with a general increase in the number of band fusion frequencies. Further research on genetic backgrounds have also shown a relationship between the local populations of *C. nemoralis* and interations between shell banding loci, which can also be subjected to natural selection.

We have also looked at similar experiments which focused specifically on *C. nemoralis* and their thermal environments. Many scientists looked at the effect the phenotype would have on their thermal environment, and deduced it could be significant enough to show a change in morph frequency ; for example: in warmer climates you are more likely to find a higher frequency of live *C .nemoralis* of yellow shells, due to the fact they are less resistant to overheating, while the pink and brown shells are more efficient at absorbing heat radiation so are more suited to colder climates. The idea of visual selection was also explored by many. The song thrush *Turdus ericetorum* is a known predator of *Cepaea*, therefore it is possible to look at the morph frequencies of *C.nemoralis* compared to its environment. It was found that in more covered slightly denser areas of woodland e.g. dead leaves and thick vegetation, higher frequencies of pink and brown shells were found, compared to open grassland where yellow shells were the majority. This reverts back to the basic need to survive; therefore camouflage could work in their favour.

The aim of the experiment is to find out how the morphology of the population changed in between covered and exposed areas. Covered areas are described as having unexposed soil, long dense vegetation and more saturated soil. It presumed that these areas would be colder because there is less direct sunlight hitting the soil. Exposed areas are described as having shorter vegetation, less saturated soil and dry ground which is exposed to more sunlight. This means that exposed areas receive more direct sunlight. In order to test this theory, two transects were laid out. Each transect contained both covered and exposed areas and snails were counted within the 3 by 3 metre quadrats to compare the differences in populations. Within each area we looked at snail colour and number of bands to see if there was a relationship between the morphology of the snail and its environment. We hypothesise that there will be multiple niche polymorphism where different phenotypes will be more suited for different niches i.e. darker snails will be found in covered areas.

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